802.1 TSN and wireless networking

Norman Finn
Cisco Fellow

21 Feb 2013
Segue Slide
802.1 Time-Sensitive Networking (TSN) Task Group

- Was 802.1 Audio Video Bridging (AVB) Task Group.
- One of four TGs in the 802.1 Higher Layers Working Group.
- One other TG is the Interworking TG, which does basic bridging.
802.1 TSN (or AVB) standards

- Completed:
  - 802.1Qat Stream Reservation Protocol (SRP) – Allows Talkers to advertise data streams characterized by a multicast destination address, VLAN, priority, and maximum bandwidth. Allows Listeners to subscribe to them, and bridges to allocate resources along the path(roms) from Talker to Listener(s). Similar in concept to RSVP classic, with the addition that reservations also advertise the availability of the stream. (Now included in 802.1Q-2011.)
  - 802.1Qav traffic shaping – Defines a hardware traffic shaper that enables the streams reserved by SRP to (pretty much) guarantee end-to-end latency and (almost) guarantee no congestion loss. (Now included in 802.1Q-2011.)
  - 802.1AS Time Synchronization – Defines a profile of IEEE 1588 that gives plug-and-play master clock selection, distribution tree generation, and time synchronization to 1 μS. Supports 802.11 Wi-Fi.
  - 802.1BA Profile to make all of the above plug-and-play.
802.1 TSN (or AVB) standards

• In progress:
  ➢ 802.1QASbt Time Synchronization – improvements for multiple masters, fast failover, better accuracy.
  ➢ 802.1Qbu Transmission preemption – Support for (hoped-for) 802.3 standard for interrupting a low-priority packet to transmit a high-priority packet, then resuming the low-priority packet.
  ➢ 802.1Qbv Scheduled Queuing – opening/closing queues on a schedule locked to the time-of-day with μS accuracy.
802.1 Interworking standards

• Completed:
  ➢ 802.1aq-2012 Shortest Path Bridging – Uses IS-IS to direct all unicast and multicast frames along the least-cost path or distribution tree.

• In progress:
  ➢ 802.1Qbp Equal Cost Multi Path – Adds an entropy tag and TTL to frames to support high-quality multipathing.
  ➢ 802.1Qca Path Control and Reservation – Supports creation of “nailed up” multiple simultaneous delivery paths for a stream based on IS-IS topology, but which are independent of IS-IS control, thus yielding high reliability without fault detection, response, or protocol convergence times.
  ➢ 802.1Qbz Bridging 802.11 – Supports placing a Wi-Fi medium in the middle of the network, as well as at the edges. An Access Point is also a Bridge, and a Bridge can have Wi-Fi stations as ports as easily as wires. Running in parallel and in cooperation with 802.11ak.
The Access Points and their co-resident bridging functions become integrated AP bridges (AP/Bs).

Devices with non-AP station capability(ies) and wired connections become “non-AP station bridges” (S).

Of course, not all stations are bridges. (The diamonds are non-bridge non-AP stations.)

Each point-to-point wireless association is presented to IS-IS as a point-to-point link – or as not present – depending on heuristics.
Link availability

• You cannot have a bridge-to-bridge link flapping; frequent topology changes will keep the topology control protocols in turmoil, and disrupt connectivity throughout the network.

• Bridge-to-end-station link flapping is a local matter, and causes no serious network problems.

• Heuristics must be applied to prevent bridge-to-bridge link flapping—a flapping link is presented to the network as either:
  ➢ Always present, which causes frame loss if the outage lasts too long; or
  ➢ Always absent, which prevents the link from being used, and perhaps partitions what was intended to be one network.
  ➢ Pick your poison and drink heartily!
Link speeds

• Similarly, the network cannot be updated as link speeds change. A single speed should be chosen, and left alone, unless (perhaps) the heuristics indicate that it is stable in the long term.

• All wireless links are represented to the network protocols as being very slow, so that the network will always prefer wired links, where connectivity permits.
Notes on heuristics

• If an unreliable wireless link must be used to achieve connectivity, then connectivity is unreliable. This is a fact, no matter what bridging or routing technology is used.

• The parameters controlling whether an unreliable link is considered up or down certainly will be managed objects; further study is required to find good default values, and to determine whether automatic algorithms can adjust them.
Does this apply to the 6TSCH problem?

• The Wi-Fi scheme will likely work with 802.15, as long as there is a backbone of always-on bridges (an 802.15 analog of Access Points). Twinkling connectivity to end stations should not be any more of an issue for bridges than for routers.

• A network based on a twinkling backbone is not going to be tackled by 802.1. I know of no good answer to this problem.

• Routers certainly know how to deal with bridged LANs at the edge, or for that matter in the middle, of a routed network. So does every application.

• Some mapping of 802.15 station identities to 48-bit addresses would be required to support transparent wired/wireless bridging, as we’re doing for Wi-Fi. This is not hard, but it is tedious to get it right in the face of splitting/merging networks, etc.
Thank you.